Systemic Design in AgroFood Sector: EN.FA.SI project

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CONFERENCE PROCEEDINGS

Edited by

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London Metropolitan University, with the International Food Design Society, is pleased to introduce the proceedings of the *International Conference on Designing Food and Designing For Food*. The conference aimed at providing a forum for the presentation and discussion of research on fundamental aspects of Food Design across all domains of application.

The conference encouraged researchers and academics to submit abstracts for a 30 minutes Paper presentations, and students to submit abstracts to display Posters summarizing their work. The conference also proposed a special session for designers and researchers to exhibit a model or prototype of their Projects and present their work in a 15 minute presentations.

The *International Conference on Designing Food and Designing for Food* follows the *1st International Symposium on Food Experience Design* held on November 9th, 2010 at London Metropolitan University. The symposium was a representation of the multidisciplinarity, transdisciplinarity and interdisciplinarity of design, food and experiential knowledge. Through six presentations from very different disciplines, the symposium created a panorama of the variety of disciplines that all contribute to Food Design. The *International Conference on Designing Food and Designing for Food* instead wanted to expand this concept to academics, researchers, professionals and research students from around the world. What are the disciplines influencing Food Design? How are these many disciplines influencing Food Design and how do these influence each other? Is Food Design now a discipline in its own right?

The conference call accepted papers from a range of different topics: Food Product Design, Design With Food, Food Packaging, Interior Design For Food, Food Events Design, Food Science, Food and Five Senses, Emotional Food Design, Food System Design, Experiential Knowledge, Food Service/Management, Food Design History, Food Styling. About 100 submissions were made among the three sessions: Papers, Projects and Posters. A double-blind peer review process selected 29 papers, 12 projects and 7 posters. Authors of Papers had to submit an abstract first and a full paper later, authors of Posters submitted an abstract, and authors of Projects submitted an abstract but were given the possibility to submit a short paper too, to be considered for publication. The following proceedings present the 29 papers presented at the conference and 4 short papers from the Projects session.

We consider this proceedings a good representation of the variety of disciplines involved in Food Design, and an accurate portrait of the current panorama of research and design applied to this discipline.

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Systemic Design in AgroFood Sector: EN.FA.SI project

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Abstract

The EN.FA.SI. project (l'ENergia e il FAgiolo in SIstema), supported by the Piedmont Region with POR-FESR 2007-13 funds on productive transition and innovation, aims to develop a specific area in the North West of Italy (province of Cuneo) through a process of ***designing for food****. The project will have a strong impact on: -the* ***Environment****: land conservation, protection of soil and native species, the consolidation of local culture, clean industrial processes, and efficient logistics; - the* ***Economy****: increasing productive activities in the area, niche businesses development, integration of different production activities; -the* ***Technology****: process innovation and efficiency; -the* ***Society****: increasing local workplaces, enhancement of the know-how mainly held by the elderly, the application of scientific innovation in the field. The design object of the project is the optimizazion/innovation of material and energy flows in the locally produced bean process (Fagiolo Cuneo). The Systemic Design (SD) studies not only the linear process, but also the inputs and outputs involved in each phase, to generate added value from what is usually considered waste. Environmental problems generate both difficulties but also the main opportunities for innovation related to Cuneo's bean supply-chain, from cultivation to distribution, from packaging design to rediscovering and promoting traditional recipes. This research evaluates the input and output of all stages of production, studies the energy needs, the flows of matter and energy and sizing a system to ensure zero impact on the environment. Cuneo's bean supply chain is of great importance for the cultural history of the province, highlighted by the presence of a 'Consortium' set up by the Chamber of Commerce of Cuneo in 1989, to promote this product registered as TFP (Traditional Food Products) and PGI (Protection of Geographical Indication).*

To ensure that this typical product with valuable organoleptic and nutritional characteristics becomes widespread it is necessary to introduce processes to ensure long term storage and faster cooking times for the end user. To achieve these goals the variety of bean chosen was Billò because its seeds have a rich pulp and the external part is thin. Furthermore, its cultivation can be strictly regulated and can be processed in an innovative way.

The project was complex and involved many local SMEs and its strengths are related to the experimentation of new products, and the test of innovative production systems. The programmed changes provide an evolution in industrial processes that were modified from linear (resource extraction, processing and production of manufactured goods and scrap) to systemic and integrated, by creating a network of companies with zero emissions.

Keywords : design&food; Systemic Design; sustainability.

Introduction

The past two decades have witnessed a growing demand for food and greater availability of synthesised products (pesticides and fertilizers). These factors have caused the transformation of seasonal and territorial activities into processes that have been totally uprooted space and time, and placed in the local area for economic and logistical factors (such as low cost of labour or proximity to motorways). As a result a steady impoverishment of the soil has occured, leading to frequent mutations of traditional cultivation and the severe depletion of top soil.

Furthermore, the culture of food gives a strategic value to the food system with its economic, social, cultural and environmental implications. According to the Millennium Ecosystem Assessment, published by the United Nations in 2004, most unsustainable human activities are related to the agri-food sector.

Cuneo bean cultivation is important for symbolic, psychological, historical, and territorial reasons. This study examines innovative productive techniques in order to increase consumption and to reduce disposal problems. The project brought together different scientific disciplines with important consequences on the quality of life in terms of food security, health and new economies (Germak, 2008).

These preliminary remarks show Design in its contemporary meaning of culture-design, extended beyond the traditional product categories and applied to their systems. The design assumes **the role of director** for a broad exploration of the field, involving important contributions from agricultural sciences for biodiversity, materials sciences, industrial production, economic sciences, as welll as nutrition, social sciences, history and landscape design. This research is necessarily multi-disciplinary and aimed to combine economic, social and environmental instances, in a renewed relationship between man and nature, culture and design, production and environment.

Methodological challenges

Only designing food as a product, without coordinating and integrating all the related functional, symbolic, cultural, technical and manufacturing factors, is an approach to overcome because it does not solve the environmental issues as a whole, but only finds spot solutions. It is necessary to acquire, and design the flows that run from one system to another in a continuous metabolism that decreases the carbon footprint and activates the local economy. This approach is called Systemic Design (SD) and it designs material and energy flows, investigating the positive changes in productive processes and activating a new economic model based on open industrial cycles (Bistagnino, 2011).

Production system become efficient and sustainable when they imitate nature, and the following are the guidelines of SD:

- *The output (waste) of a system becomes input (resource) for another,* creating an increase in cash flow and new job opportunities;

- *Relationships generate the system itself:* each relationship contributes to the system and it can be whithin the system or outside of it;

- *self-producing systems support and reproduce themselves*, thus allowing them to define their own paths of action and jointly coevolve;

- *Act locally: the local context is fundamental.* Acting locally values local resources (human, culture and material) and helps to solve local problems by creating new opportunities;

- *People at the center of the project* (Germak, 2008) to be connected to their own environmental, social and cultural context.

This study starts with a holistic survey of the current situation that clearly outlines all the steps and the actions undertaken or undergone by the context in question (Cuneo Province). The quantities of what enters the system were analysed, together with what happens inside it the quantities of what comes out of it, their destination and possible uses. In addition, the players involved in the system, their nature, their know-how and the available technologies were studied. Furthermore, the relationship occurring between the parties and the context, as well as their communication were taken in consideration.

Data on incoming and outgoing flows of materials and energy are provided. This includes information about their nature, their origin and their future use or destination, is a process where they have undergone different transformation phases. Some of these required higher quantity of energy, while others are more sustainable with regard to the resources of the context where the process takes place. As a result, we obtain a global vision of the process and of the overall relationships that characterize the system and make it work.

At this point one can notice how “useless” and contradictory it is to focus merely on the individual parts, ignoring the links with the elements existing inside, outside and all around the processes. Moreover, an approach by single parts has proved to be in contrast with the dynamism of the whole and with the "traditional" efficiency of the natural systems we can purposefully take as an example. The safeguard of this global vision, beneficial to the sustainable transformation of the processes, can be attained by drawing a graphic chart, allowing to retrace the flows of matter and energy, their use, the knowledge capitals, the relationships between the actors, and the contextualization of the system in analysis.

Identifying the problems and trying to understand them leads to a clearer perception of the phenomena they have arisen from. Physics, biology, chemistry, mathematical sciences, history and economy, are the indispensable tools for this analysis (Tamborrini, 2009).

A designer is asked to coordinate, enhance and harmonize their contributions and to change the faults in the dynamic flow of productions. As a consequence, he may be better equipped to delve into the problems, to understand causality relationships between phenomena and to discern the priorities of the planning process, in compliance with the information provided by nature, an unparalleled model of efficiency (Barbero, Cozzo, 2009).

The design becomes a matter of culture and the ability to modify reality based on the planned processing of available resources. This is carried out in accordance with certain schedules and with results that are established beforehand, thus making it an intermediary for the production and consumption systems (Celaschi, 2008).

Design activity is always characterised by its observation of reality, by the creation of a simplified model of reality, and by manipulation of this model in order to transfer the physical outcome back into reality. It is the interdisciplinary mix, which is drawn upon and the processing route that is embarked upon in order to rich the desired synthesis. The polytechnic culture provides the sensitivity of studying and working in this area of sustainable equilibrium.

Empirical challenges

The methodology is based on multi-criteria analysis and involves stakeholder participation to provide a locally customised evaluation based on environmental indicators, to better understand the theoretical methodology and the results on agrofood sector, we applied it in a specific project EN.FA.SI. (l'ENergia e il FAgiolo in SIstema, translated in Energy and Beans into the same System).

This project shows the potentialities of dried bean market if the whole system is re-designed, introducing new products/services and reducing the environmental impacts. For this project was chosen a specific bean, typical of Cuneo Province (North West of Italy). Many solutions are taken in consideration to verified the benefit at economical, social and environmental level for the different kind of conserved products.

Using the SD methodology we obtain two main results:

- test the theory in practice;

- design a real complex system, that can be show as best practice.

Environmental criticalities are, at the same time, the main opportunities for innovation related to Cuneo's bean supply-chain, from cultivation to distribution, from packaging design to rediscover and promote traditional recipes.

EN.FA.SI. project

Overview

The project EN.FA.SI. evaluates the input and output of all stages of production, studies the energy needs, the flows of matter and energy. In this way, the design process has a broader vision of renewal and enhancement of an entire area with the people who live there, putting them at the center of the project.
The Cuneo's bean is of great importance for the cultural history of the province, highlighted by the presence of a 'Consortium' up in the Cuneo's Chamber of Commerce in 1989, to promote this product registered as Traditional Food Products (TFP) and Protection of Geographical Indication (PGI).

To ensure an high spread of this typical product with valuable organoleptic and nutritional characteristics, it is necessary to process it for ensuring long term storage and fast cooking by the end-user. To achieve these goals the variety of bean chosen is Billò because its seeds have rich pulp and the external part is thin, furthermore, it grows in the field in according to a precise specification and it is processed in an innovative way (pre-cooking with steam and dehydration with cold air).

The Cuneo's bean is a crop with great potentiality in the area, with many strengths, that are not yet fully expressed, but there are also some weaknesses that limit and, in the meantime, characterize the crop. The various aspects are assessed in a S.W.O.T. analysis, in table 1.

S.W.O.T. ANALYSIS	
Strenghts	**Weaknesses**
Good climatic condition	Low availability of registered plant protection and weed killer
Perfect land caracteristic	General lack of stable material
Experience of agricultural entrepreneurs	Low knowledge in fertilization
Typical production	mechamization in delivery products for plant protection
Unique product with low competition	watering
Mechamization of seeding and harvesting phases	Land problems with plant protection
Many typical varieties	Tight rotations in specialized companies
Opportunities	**Threats**
New markets	New problems related to plant protection
Industrial trasformations to obtain new products	Decreasing of rotations and stubbles
Valorization of the product (PGI)	Increasing of new products without the right organization
The production is concentrated in a specific area	Availability of external labour
Recovering and increasing local species	

Table 1: SWOT analysis of Cuneo's bean system.

Local network: actors

The project is complex and involves many local SMEs, that gave the chance to experiment new products, and test innovative production system.
The programmatic change provides an evolution in industrial processes that are modified from linear (resource extraction, processing and production of manufactured goods and scrap) to systemic and integrated, by creating a network of companies with zero emissions (Figure 1).

Agrindustria snc: it is a small enterprise in Cuneo that processes biomass from agricultural waste to generate products to industry.

Its role in the project: overall coordination and development of the feasibility study especially for the industrial trasformation of the bean (steaming and drying in a controlled environment).

Industrial Design (Politecnico di Torino): the research group Systemic Design from Politecnico di Torino applies the theory of complexity to various industrial sectors including the agrofood. The primary objective of the research group is to develop a renewed culture of quality in production.

Its role in the project: design the whole production chain of Cuneo's bean from linear to systemic (waste from one system becomes input for another), tending to zero emissions.

Agroinnova: research center that operates in the field of agro-environment sector for the transfer of knowledge and technologies. It was set up in 2002 by the University of Turin.

Its role in the project: Technology transfer for the feasibility study in mapping local production and check the quality of cultivation.

Arese Franco: family business specialized in cleaning and drying grain products, such as legumes, cereals, dried fruit and green coffee beans, especially from organic production. The company has facilities for the dust extraction, for the removal of small stones, for the elimination of other foreign bodies, for the grading, and for electronic selection.

Its role in the project: it is the junction between the farmers and the industrial processes. It selects the raw beans from farmers, to make them suitable for human consumption. Cleaning and sorting the beans from the field, allows to proceed with the next industrial manufacturing phases.

CReSO: in Piedmont Region, it makes applied research in agronomic sector, as protection of horticultural germplasm, varietal innovation, and defense.

Its role in the project: it schedules seedings annually for the varietal innovation, at the Horticultural Experimental Center in Boves (CN). It works on seed treatment for the reduction of pathogenic telluric; on localized irrigation, on diversified amounts of water; on fractional contribution of nutrients. Furthermore, it selects regional bean in conservative way (climbing ecotypes for the production of grain).

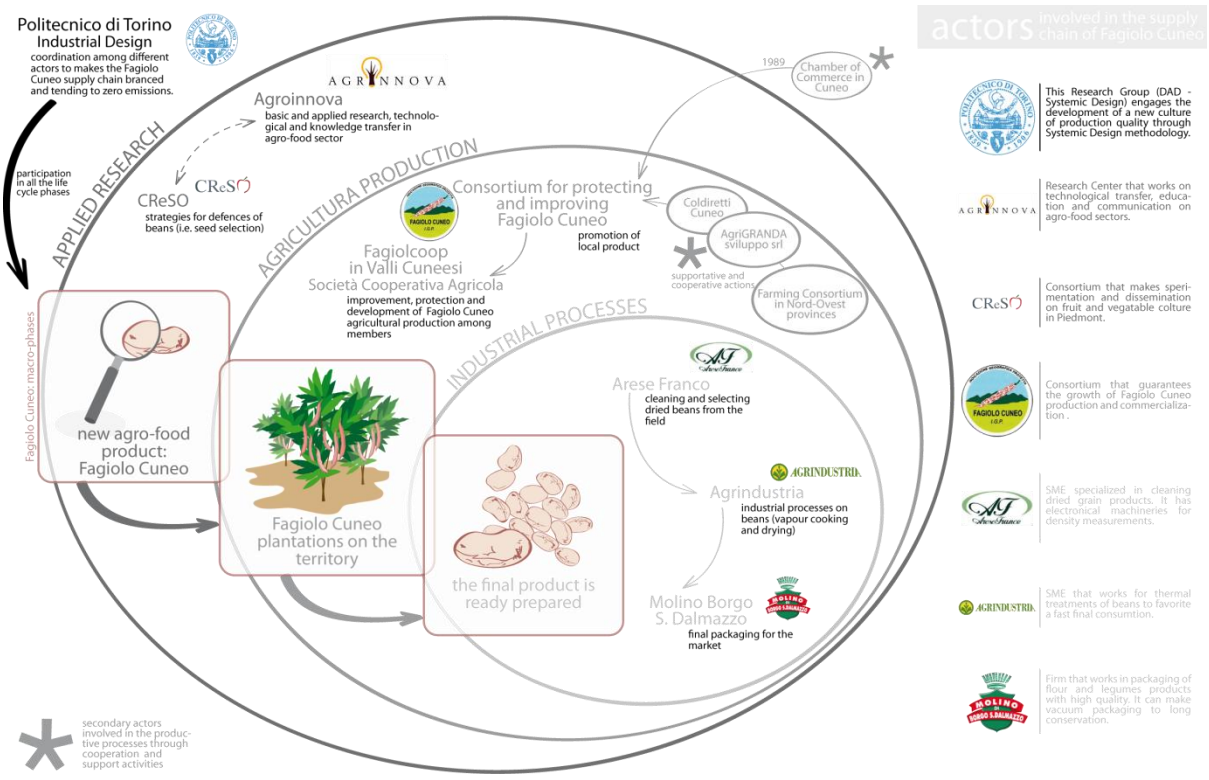

Figure 1: present and potential stakeholders of EN.FA.SI. project.

Results

The production of beans in the Province of Cuneo is divided into two types:

1- dry bean, harvested mechanically after drying on the plant;

2- fresh beans, collected manually at the waxy stage of maturity.

Besides historical and cultural importance of the bean, in recent years, it has proved a good crop from the economic point of view, surely one of the most profitable crops in the area due to the Gross Saleable Production (GSP), which comes to 20,000.00 € / ha .

Bean production in the Cuneo area is concentrated in a radius of 20 km, while the industrial operations of transformations are more concentrated (just 10 km). This strict localization permits to design a plan of territorial development defined and precise.

Environment:

- *land conservation and protection of soil:* comprehensive and accurate maps of the current situation are generated by authoritative sources as field studies, and, most of all, by data bank and direct first-hand interview to local farmers. We have implemented a dual source: scientific literature and basic empiricism (large mass of direct data) to obtain a small approsimation degree. The first source makes possible an advancement in the field research, that is inevitably more expensive, delicate and demanding on time and human resources, but it provides the most innovative results.

- *protection of native species*: defence strategies to use selected seeds with the aim of promoting the development of safer production methods and healthier foodstuffs, while safeguarding the competitiveness of agricultural enterprises.

- *perpetuation of local culture:* enhancement of a PGI product, guarantee by a secure system from the cultivation stage to the consumption stage. The performed actions in each individual plots of land are: soil preparation, agronomic practices, pest management, management of defence against animals and plants, harvesting of beans and harvesting of “waste” biomass.

- *clean industrial processes*: different ways to process the beans and make them ready in few minutes by the consumers are analysed and verified. The steam cooking and the dehydration were chosen for their low environmental impact.

- *Efficient logistics*: in figure 1, it is clear how close are the different stage of production. Furthermore, also the packaging was designed to have a product eco-friendly in materials used, in optimization of volumes, and in communication.

Economic:

- *increase productive activities in the area:* the territory is enhanced thanks to those are still considered waste materials, but with their new value, given by their intrinsic qualities, they can become a benefit for the area. The biomass wasted in crop is directly used to generate the energy for the industrial processes of the bean. The integrated management of the energies involved in the project generates real advantage to the local communities, and not to a single company.

- *integration of different production activities*: design micro-CHP system (about 180 kWe) for electricity and heat to make the entire system self-sufficient. Renewable energy is derived from residues in the food chain of the same Cuneo's bean and from the surrounding territory, with a radius no more larger than 20 km from the production center. This energy management is environmentally and economically beneficial for the area.

- *niche businesses development:* the economic interest of the companies that produce beans is given an efficient mechanization in seeding and harvesting phases, so that the manual operations are decreased, as well as the costs of labor (Baudino and Jordan, 2004). With regard to the average trend in prices in recent years the cultivation of the bean is one of the few vegetable productions, perhaps the only one, that has a constant level of market prices, with increases, despite a contemporary larger area of production than before.

Technological:

- *processes innovation:* new technique of food are used, which removes the free water present in the food gaining so the low level of water residual that prevent the bacterial growth and the biochemical reactions. This technique is cold because beans are not heat resistant food, so if we dehydrate them with heat, they will lose nutritional factors (vitamins), they will oxidate or they will getting dark (Maillard browning), they will smell bitter and they will lose their important nutritional values. The dehumidification system allows to dry the beans avoiding fermentation and oxidation, and preserving the organoleptic and enzymatic characteristics, and therefore its complex phyto-food structure.

- *efficiency:* production processes have been optimized to minimize power consumption, furthermore, the energy used is green (energy from renewable sources). For this production is designed and installed a micro-CHP system (up to 180 kWe) in the company that cook and dehydrate the food product.

Social:

- *increase local workplaces:* the activation of different economies of scale generates an increase in revenues, sales, and jobs available in the area (it is estimated to activate 50 new job positions in 5 years).

- *enhancement of the know-how mainly held by the elderly*: facilitation of knowledge that resides in elderly with the young enterprise. The project valorises the know-how of elderly that used to work these beans in a traditional way with many moments of exchange between tradition and new techniques. Furthermore, the traditional food recipes are rediscovered.

- *apply scientific innovation in the field:* SD guidelines are the basis of methodological approach to the project, the essential tools to understand the entire system and to start the definition of possible useful relationships among the elements of the system.

Taking the project forward: conclusions

The acquisition of a stronger awareness of the link between social development and rural development, allows to promote the complementarities of the resources in the countryside, and to intervene more directly in the generation of relational values at environmental and economical levels.

From this point of view, the actions of social development in rural areas that were defined with EN.FA.SI. project, can be framed at different levels of work:

- the consolidation of a social protection system consistent with the specific rural contexts, the present needs, and the widespread relations;

- the exploitation of business systems and life styles that are based on the values of hospitality, reciprocity, and trust;

- consumption of safe and traditional food.

The system concept eliminates the focus on a single product and tends to favor the complexity, size, local flexibility, which allows to normalize and revitalize the bonds of each company with its own context based on the outputs produced.

A systemic approach may lay the foundation for better, positive use of resources and, consequentially, for a macro autopoietic system shaped by all micro territorial systems and developed by new relational networks that become the messengers of a positive environmental and territorial change (Barbero, Toso, 2010).

The project will be probably enriched by applying the same methodology in other sector, for example the grape industry, because the same Cuneo Province is known worldwide for the quality of the wines. But there are still many potentialities that are not being used, for example in the field there are a number of problems associated with synthetic pesticides, with supports, with pruning, with

transformation phase and so on. Taking into account the 21,000 hectares of grapes in Cuneo Province, producing on average 26,000 tons of grapes / year, the estimated cost for the disposal of their wastes is about 8 million €. These wastes may find many applications in the cosmetics, clothing, and energy sector, turning these costs into profits.

The current trend is to look at product features that are assessed by norm-referenced tests that regard one individual unit. Conversely, with the systemic approach, the sense of belonging to the system is deemed to be the real added value. The interdependence links developed among the parties by the outputs/inputs guarantee that all the players have positively checked on one another. By doing so, we will have good food/products, as well as a healthy territory and natural system. Being part of a "system" is to be the only legitimate and objective future certification (Maffei, 2011).

Certification represents a type of non-state governance mechanism which transforms power relationships, creating new global spaces with new links among highly diverse and often antagonistic actors.

The "alternative agri-food networks" (AAFNs) are defined as such due to their 'turn' away from productivist, standardised and industrial systems of food provisioning towards a focus on notions of 'quality', 'place' and 'nature' (Goodman, 2003, 2004). Buller and Morris (2004, p. 1069) argue that the emergence of those networks, at least in Europe and North America, appears to form part of ''a new rural development, food quality and sustainable farming agenda'' (see also Marsden, 2003; Marsden and Sonnino, 2005; Renting et al., 2003). AAFNs which seek to develop a more direct relationship between producers and consumers, as opposed to the distant and highly commercialised producer–consumer relations fostered through "conventional" food production. Re-localised AAFNs offer a closer connection with the point of production, thereby improving food quality as well as restoring public confidence and trust in food production. They operate through local and regionally grounded frameworks of association, based largely on non-economic dimensions of trust and regard (Kirwan, 2006) as opposed to the more bureaucratised and formalised relations of governing found in delocalised "conventional" food networks (Marsden and Sonnino, 2005; Renting et al., 2003; Sonnino and Marsden, 2006a).

Design has evolved to become the link between human and social needs and industrial practices. These collaborative projects build on the premise that the broader the diversity of information, practices and cultures design students are exposed to the more open their perspectives will be and the more adept they will become at participating in and facilitating the creation of more innovative sustainable solutions (McMahon and Tracy Bhamra, 2012).

The development of innovative design solutions may be greatly enhanced through a process of collaboration, collective knowledge generation and sharing, multi-disciplinarity, holistic perspectives and understanding of diverse cultural backgrounds (Designophy, 2001).

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